Appendix 5:
Method of Calculating Results for the BestPractices Program

Method of Calculating Results for the BestPractices Program

In support of the Industrial Technologies Program's (ITP's) mission to improve the energy intensity of the U.S. industrial sector, BestPractices is designed to provide industrial plant managers with information to evaluate opportunities and implement projects that improve the efficiency of energy systems within their production facilities. These process-supporting energy systems include those with motors and drives, pumps, air compressors, steam, and process heat. BestPractices relies on four main activities to deliver technical information to a target audience of medium- and large-size manufacturing establishments: 1) plant-wide assessments (PWA), 2) training, 3) software tool development, and 4) qualification of specialists by BestPractices to address industrial applications of energy-intensive pumping, compressed air, steam, and process heating systems. To a lesser extent, BestPractices also uses publications, direct technical assistance, and public-private partnerships to deliver information to targeted manufacturers.

Estimates of energy savings presented in this report are based on a methodology originally developed by Oak Ridge National Laboratory in 2002 and refined as the result of a peer review conducted in 2004. The impacts presented for FY 2004 BestPractices activities reflect the on-going efforts to implement recommendations from the peer review and improve the accuracy of savings estimates. Improvements include: 1) integration of results from a participant survey, 2) better understanding of energy characteristics of participating plants, 3) consistent registration information for software users, and 4) follow-up implementation information from plant-wide assessments. Savings estimates for years prior to FY 2004 have not been adjusted to reflect these most recent improvements.

The ITP Tracking Database provides data on participants in all activity areas and uses the data to estimate output and savings outcome performance of BestPractices. Participants include representatives from domestic or international manufacturing plants, corporations, research or educational institutions, state and local governments, and engineering or consulting organizations. Using information on participant affiliation, the tracking database provides estimates of the number of unique, domestic plants participating in each activity. The number of unique plants is then scaled back to estimate the number of unique, U.S. plants that are believed to take action to implement energy savings projects as a result of the dissemination of this information.

Estimates of energy savings from BestPractices' activities focus on the four core activities of PWAs, training, software, and qualified specialists. As a result of the peer review, estimates were constrained to these activities because of their significant savings potential and the higher quality of available data. The basic methodology for estimating the energy outcome of BestPractices is a combination of averaged energy savings reported by PWAs and calculated savings for training, software use, and qualified specialists. Energy benefits generated by PWAs are based on engineering estimates of savings identified in assessment reports and plant followup. Savings associated with unique U.S-based plants that implement projects following interaction with qualified specialists or by participating in training or use of software are estimated using historical assessment data from BestPractices and the Industrial Assessment Centers (IACs). Savings and descriptions for each of the four main delivery activities are summarized below.

Plant-Wide Assessments

Plant-wide energy assessments identify overall energy use in manufacturing processes and highlight opportunities for best energy management practices for industry, including the adoption of new, efficient technologies. Plants are selected through a competitive solicitation process and agree to a minimum 50% cost-share for conducting the assessment. A PWA team conducts an on-site analysis of total energy use with plant personnel and identifies opportunities to reduce energy use and costs. BestPractices initially offered PWAs in FY 2000.

In FY 2004, 9 PWAs were completed and replication activities occurred at 5 additional plants. Original PWAs reported identified savings totaling 3.6 TBtu. Similarly, plants that replicated PWA results elsewhere identified savings totaling 3.3 TBtu. Previous year savings from PWAs are assumed to persist for seven years, which add 20.5 TBtu in savings for FY 2004. BestPractices PWAs saved 27.4 TBtu in FY 2004 and cumulatively saved 59.3 TBtu from FY 2000 through 2004.

Method of Calculating Results for the BestPractices Program

Training

Training activities continue to play a key role in the BestPractices' strategy. Participants who attend end-user training learn how to apply the software in their own plants to identify and implement savings in energy-intensive systems. The number of unique plants participating in a training activity is recorded in the ITP Tracking Database. From 1998 through 2004, representatives from nearly 3,000 unique plants attended BestPractices' training sessions. In 2004, of 693 plants attending training sessions, about 347 were estimated to actually take action to implement projects in their own energy-intensive systems, resulting in an estimated savings of 5.77 TBtu. Additionally, savings that persist from measures implemented as a result of training conducted in previous years contributed 44.0 TBtu in FY 2004. BestPractices' training saved 49.8 TBtu in FY 2004 and cumulatively saved 142 TBtu from FY 1998 through 2004.

Software Tools Distribution

BestPractices has a variety of resources to help address a company's energy management needs and facilitate energy-efficiency decision-making. A range of software tools is available to help a plant manager perform a self-assessment of a plant's motor, pumping, compressed air, steam, or process heating systems. Software tools available in FY 2004 included AirMaster+, MotorMaster, Pumping System Assessment Tool (PSAT), Steam System Scoping Tool, Steam System Assessment Tool, Process Heating Assessment Tool (PHAST), and 3E Plus. Users may download the software from the BestPractices website or use the Decision Tools for Industry CD, which contains the entire suite of BestPractices' software tools.

Software is proving to be a powerful means of disseminating technical information for BestPractices. According to the tracking database, over 1,800 unique plants obtained BestPractices' software in FY 2004. Over 360 plants are estimated to have taken action to implement projects, saving an estimated 3.62 TBtu. Savings from measures implemented in previous years that persist in FY2004 contributed 32.4 TBtu. BestPractices' software saved 36.0 TBtu in FY 2004 and cumulatively saved 109 TBtu from FY 1998 through 2004.

Qualified Specialists

Qualified specialists are industry professionals who have completed additional training and demonstrated proficiency in using BestPractices' software tools. Specialists apply these tools to help industrial customers identify ways to improve system efficiency. In FY 2004, BestPractices offered specialist qualifications in the following software tools: Steam Systems, PSAT, AirMaster+, and PHAST.

By the end of FY 2004, nearly 300 software specialists were qualified by BestPractices. That same year, an estimated 667 plants interacted with qualified specialists, resulting in implemented projects at 352 plants. Estimated savings from qualified specialists' activities in FY 2004 are 5.12 TBtu. Savings that persist in FY 2004 from measures implemented in FY 2001 through 2003 contributed 3.30 TBtu. Qualified specialists saved 8.42 TBtu in FY 2004 and cumulatively saved 12.7 TBtu from FY 2001 through 2004.

Conclusion

The table below shows the total annual energy savings from ITP's BestPractices activities from 1998 through 2004. The subtotals from the four delivery activities are added together to calculate the total annual energy savings for FY 2004 of 122 TBtu and a cumulative energy savings of 322 TBtu. Fuel prices and emission coefficients for various fuels from Energy Information Administration publications were used to determine cumulative energy cost savings and carbon reduction.

Method of Calculating Results for the BestPractices Program

	1998	1999	2000	2001	2002	2003	2004
Plant-Wide Assessments							
Unique Plants Implementing Improvements Each Year			2	14	17	8	9
New Plant Replications				1	10	22	5
Annual Energy Savings from Plant-Wide Assessments *(TBtu)*			0.61	1.28	9.45	20.5	27.4
Cumulative Energy Savings from Plant-Wide Assessments *(TBtu)*			0.61	1.89	11.3	31.9	59.3
Training							
Unique Plants Reached Each Year	75	150	300	330	791	652	693
Unique Plants Implementing Improvements Each Year	38	75	150	165	396	326	347
Annual Energy Savings from Training *(TBtu)*	0.84	2.51	5.86	10.2	28.5	44.0	49.8
Cumulative Energy Savings from Training *(TBtu)*	0.84	3.35	9.21	19.4	47.9	91.9	142
Software Tools Distribution							
Unique Plants Reached Each Year	479	959	4,793	10,718	9,608	5,847	1,842
Unique Plants Implementing Improvements Each Year	96	192	959	2,143	1,922	1,169	368
Annual Energy Savings from Software *(TBtu)*	0.24	1.04	4.63	13.3	21.1	32.4	36.0
Cumulative Energy Savings from Software *(TBtu)*	0.24	1.28	5.91	19.2	40.3	72.7	109
Qualified Specialists							
Number of Qualified Specialists				27	89	177	300
Unique Plants Interacting Each Year with Qualified Specialists				13	43	85	667
Unique Plants Implementing Improvements Each Year				7	22	43	352
Annual Energy Savings from Qualified Specialists *(TBtu)*				0.17	0.77	3.30	8.42
Cumulative Energy Savings from Qualified Specialists *(Tbtu)*				0.17	0.94	4.24	12.7
Sum of All BestPractices Areas							
Unique Plants Reached Each Year	554	1,109	5,095	11,076	10,469	6,614	3,216
Unique Plants Implementing Improvements Each Year	134	267	1,111	2,330	2,367	1,568	1,081
Annual Energy Savings *(TBtu)*	1.08	3.55	11.1	25.0	59.8	100	122
Cumulative Energy Savings *(TBtu)*	1.08	4.63	15.7	40.7	101	201	322
Energy Cost Savings *(B$)*	0.005	0.022	0.088	0.235	0.560	1.18	1.93
Carbon Reduction *(MMTCE)*	0.019	0.083	0.282	0.732	1.81	3.61	5.80

Appendix 6:
Methodology for Technology Tracking and Assessment of Benefits

Methodology for Technology Tracking and Assessment of Benefits

Technology Tracking

For over 27 years, the Industrial Technologies Program (ITP), previously the Office of Industrial Technologies (OIT), has been tracking and recording information on technologies developed through cost-shared R&D projects with industry. The tracking process considers technologies that can be classified as commercially successful, mature, or emerging.

When full-scale commercial units of a technology are operational in private industry, that technology is considered commercially successful and is on the active tracking list. When a commercially successful technology unit has been in operation for approximately 10 years, that particular unit is then considered a mature or historical technology and is usually no longer actively tracked.

Emerging technologies are those in the late development or early commercialization stage of the technology life cycle (roughly within one to two years of commercialization). While preliminary information is collected on emerging technologies, they are not placed on the active tracking list until they are commercially available to industry.

The active tracking process involves collecting technical and market data on each commercially successful technology, including details on the:

- Number of units sold, installed, and operating in the United States and abroad (including size and location)
- Units decommissioned since the previous year
- Energy saved by the technology
- Environmental benefits from the technology
- Improvements in quality and productivity achieved through use of the technology
- Any other impacts of the technology, such as employment, effects on health and safety, etc.
- Marketing issues and barriers

Methods of Estimating Benefits

Information on technologies is gathered through direct contact with either vendors or end users of the technology. These contacts provide the data needed to calculate the unit energy savings associated with an individual technology, as well as the number of operating units.

Unit energy savings are unique to each individual technology. Technology manufacturers or end users usually provide unit energy savings, or at least enough data for a typical unit energy savings to be calculated. The total number of operating units is equal to the number of units installed minus the number of units decommissioned or classified as mature in a given year—information usually determined from sales data or end user input. Operating units and unit energy savings can then be used to calculate total annual energy savings for the technology.

The cumulative energy savings represents the accumulated energy saved for all units for the total time the technology has been in operation. This includes previous savings from now-mature units and decommissioned units, even though these units are not included in the current year's savings.

Once cumulative energy savings have been determined, long-term impacts on the environment are calculated by estimating the associated reduction of air pollutants. This calculation is straightforward, based on the type of fuel saved and the pollutants typically associated with combustion of that fuel. For example, for every million Btu of coal combusted, approximately 1.25 pounds of sulfur oxides (known acid raid precursors) are emitted to the atmosphere. Thus, every million-Btu reduction in coal use results in the elimination of 1.25 pounds of polluting sulfur oxides.

The results for annual and cumulative energy saving, as well as cumulative pollutant emission reductions for actively tracked technologies, are shown in Table 1 on pages 8 and 9.

Methodology for Technology Tracking and Assessment of Benefits

Deriving the ITP Cost/Benefit Curve

The approach to estimating the net benefits of ITP energy savings used here relied on the following methodology: First estimate the Cumulative Production Cost Savings which provides an estimate of the gross benefit of the ITP program since its inception. Next estimate the Cumulative Appropriations that were allocated by the government to support the development of these technologies that saved energy. Finally make adjustments to the gross energy savings to account for the cost to industry of adopting the new technologies. The method is based on the following sequence of steps:

- Cumulative energy savings – the accumulated energy savings (Btu) produced by ITP-supported technologies have been commercialized and tracked since the program began. As of 1997, this figure was 1662 trillion Btu and in 2004 it was 3,270 trillion Btu.

- ITP appropriations – cumulative funding provided for ITP programs. As of FY 2004, this number was $2.30 billion.

- Cost of industrial energy saved – the average fuel price (dollars/Btu) that would have been paid to purchase energy multiplied by annual savings. Average industrial energy prices since 1978 are constructed based on Bureau of Labor Statistics (BLS) fuel price indexes. The nominal prices (in dollars per million Btu) for various fuels are reported in the Energy Information Administration's Annual Energy Review; these are extended back in time by applying the BLS producer price index for number 2 fuel oil, natural gas, coal and electricity, normalized to a base year (currently 2000). These annual fuel prices are multiplied by the amount of energy saved per fuel type per year for each of the ITP commercialized and tracked technologies.

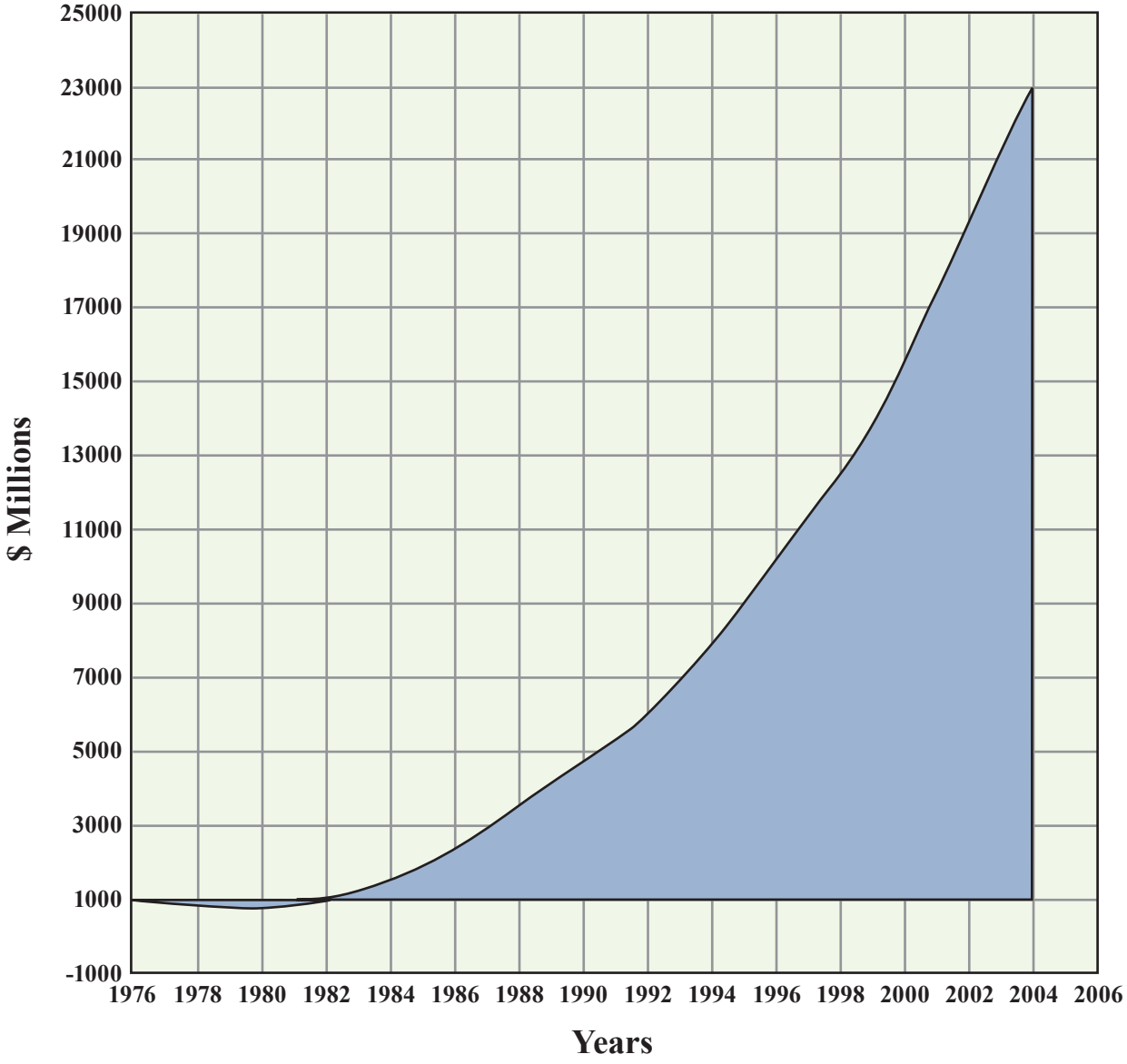
- Correct for Implementation Costs – Since we do not have reliable information about the incremental capital and operating and maintenance costs of these new technologies, an assumption must be made to adjust for these costs. The assumption we use is that industry demands at least a two-year payback period on all such investments, so we ignore the first two years of the cumulated energy savings for each of the technologies, arguing that these first two years savings are needed to recoup the life-cycle capital costs of adopting the new technology.

For each technology, the annual energy savings by fuel type is multiplied by the price of that fuel with price adjustments reflecting current costs of that fuel. The sum of all energy saved times the average energy price yields an estimate of the annual savings for all technologies in that particular year. In addition to technology energy savings, savings from the IAC and BestPractices Programs were also determined on an annual basis as described in Appendices 4 and 5, respectively. The net economic benefits are the accumulation of these savings over time with the net economic costs being ITP appropriations and the implementation costs reflected in the two-year payback period. These net benefits are then adjusted for inflation using the annual implicit price deflator for GDP, as published by the Bureau of Economic Analysis of the U.S. Department of Commerce, but renormalized to the current year so that all savings are reported in 2004 dollars.

Just as there may be benefits not accounted for by this method – spin offs, derivative technologies, etc. – there may be incremental costs not accounted for by this method. For example, there may be incremental capital costs associated with the use of a particular technology that are not currently captured in the tracking process, and thus are not included in the cost side of the equation.

The results of the application of this method are shown in the graph on page 162.

Cumulative Production Cost Savings Minus Cumulative Program and Implementation Costs



The cumulative Federal costs for the ITP Programs through fiscal year 2004 total $2.30 billion. Cumulative energy savings from completed and tracked ITP projects and programs add to approximately 4.72 quadrillion Btu in 2004, representing a net cumulative production cost savings of $23.1 billion after adjusting for inflation (using the implicit price deflator for GDP, renormalized to 2004). These production cost savings represent the net total value of all energy saved by technologies developed in ITP programs plus the energy cost savings from the IAC and BestPractices Programs, minus the cost to industry of using the technologies (estimated by assuming a two-year payback on investment) minus ITP Program costs. The graph shows that benefits substantially exceed costs.

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February 2006